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MILK-DISTRIBUTION COSTS in WEST VIRGINIA:

III. A Study of the Costs Incurred by 67 Producer-Distributors in the Charleston, Huntington, and Parkersburg Markets for a Twelve-Month Period During 1935-36

by L. F. HERRMANN

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Milk-Distribution Costs in West Virginia: III.

A Study of the Costs Incurred by 67 Producer-Distributors in the Charleston, Huntington, and Parkersburg Markets for a Twelve-Month Period During 1935-1936

by L. F. HERRMANN

Approximately one-half of the fluid milk sold in West Virginia cities is bottled and distributed by producer-distributors. The costs of distribution represent about half the cost of the milk to the consumer. They probably represent more than half of the *cash* expenses of the producer-distributor. Thus they are of interest to the consumer, who wishes to know how efficiently the service is performed, and to the producer-distributor, who wishes to know how his efficiency may be increased.

Purpose of the Study

This is a report of one of a series of cost-of-distribution studies[1], which is being paralleled by a series of cost-of-milk-production studies[2]. These studies were begun in response to a demand for data useful in arriving at price agreements, but in addition to this use an analysis of the data shows differences in efficiency among producer-distributors and shows also some of the factors responsible. As a result it may be possible for producer-distributors to study their own businesses in the light of these findings, and to improve their efficiency. The findings in the distribution cost study for plants and in the studies of costs of milk production round out the cost information necessary for discussions of price adjustments.

Methods Used in the Study

The method of obtaining these data was given in detail in Bulletin 270. Briefly, it consisted of the selection of a number of producer-distributors at random from among those in each market. The selected dairymen were given record books in which they kept an account of expenses for one year, with the help of a representative of the department of agricultural economics. The data consisted of inventories; quantities of

[1]West Virginia Agricultural Experiment Station Bulletin Nos. 266, 270.
[2]West Virginia Agricultural Experiment Station Bulletin No. 268.

milk, cream, and other dairy products that were produced, or purchased, and sold; amount and cost of labor used; cash expenses; and miscellaneous information concerning truck mileage, number of customers, etc.

Definition of Terms

The following terms have been defined in previous bulletins of this series, but since their general use is not standard, the definitions are repeated here.

1. *Producer-distributor,* a producer of milk who packages and sells his milk, cream, and other products direct to the consumer or to another retailer. He maintains a milk route, and in some cases he may buy milk to supplement his own production.
2. *Fluid sales* is a term used to include the sales of milk in the form of (a) milk; (b) cream; and (c) other products such as chocolate milk, buttermilk, skimmilk, butter, and cheese.
3. *Unit.* Each container is considered as one unit. Each can or bottle of milk or cream, and each container of cheese, etc., regardless of size, is considered a unit.
4. *Wholesale.* Fluid sales to stores, restaurants, and consumers of large quantities at wholesale prices.
5. *Retail.* Fluid sales at retail prices.
6. *Cost of distribution.* Cost of selling milk from the time it passes over the cooler until it is delivered and paid for by the purchaser.
7. *Interest costs* are included as a cost calculated at 5% of the average investment during the year.
8. *Milk-equivalent* is the sum of the sales of whole milk, plus the amount of milk required to supply the butterfat contained in other products sold.
9. *Volume* or size is compared on the basis of the total pounds of milk-equivalent sold annually.
10. *Average investment* is the total of beginning and ending inventory values of buildings, equipment, supplies, and accounts receivable for the year divided by two.
11. *Depreciation* represents the difference between the sum of beginning inventory value plus purchases of equipment and improvements, and the sum of ending inventory value plus any sales of equipment.
12. *Trips per bottle* refers to the total number of units sold in bottles divided by the total number of bottles lost during the year.
13. (a) *Operator* is the owner or renter of the business.
    (b) *Family labor* is the labor of any member of the family including wife, brother of operator, sons, daughters, etc., even though they may be paid a regular wage.
    (c) *"Other labor"* is all labor except family and operator labor.

Besides the use of the above terms the common usage regarding some items comprising or affecting the cost of distribution is indefinite. Costs per cwt. of milk in this study were based on the milk-equivalent

of fluid sales, since that was the most nearly accurate figure available. In most instances the milk produced was not weighed and the amount of milk used by the family could not be readily determined. Consequently the amount of milk lost in the process of distributing could not be determined. The cost of distribution based on fluid sales should be approximately equal to the cost based on the quantity of milk received at the milk house plus a charge amounting to the value of lost milk.

As given in this report, the amount of labor in distribution includes the actual time spent in bottling the milk, preparing other milk products, delivering, cleaning up, and work on such records as were kept. The values used for operator's and unpaid family labor were estimated by each operator. The cost of hired labor includes the actual cash expense, plus the value of allowances such as board, laundry, house rent, garden, etc. Only the cost of that part of the laborer's time spent in milk distribution was charged to the dairy.

Each producer-distributor had a number of accounts that were uncollectible. The amounts of such accounts that resulted during the year's business were estimated by each cooperator and charged as a cost of distributing milk.

All other items were cash expenses charged at actual cost.

TABLE 1—*Average volume, cost, and related data for 67 producer-distributors*

Item	Charleston	Huntington	Parkersburg	Average
Number of records	27	23	17	67
Pounds milk-equivalent sold annually	132,334	129,401	179,753	143,359
Average gallons of milk sold daily	42	41	57	46
Number of units sold annually	77,607	67,722	104,167	81,239
Total cost of distributing	$3,081.19	$2,475.16	$2,732.47	$2,784.67
Total average investment	$2,635.52	$1,893.04	$2,336.93	$2,306.38
Total hours labor	5,297	4,398	4,844	4,873

AVERAGE VOLUME OF PRODUCER-DISTRIBUTOR'S BUSINESS

Table 1 shows the average volume per producer-distributor and other data indicating the average size of business. There were 67 cooperators in this study: 27 in the Charleston market, 23 in the Huntington market, and 17 in the Parkersburg market. The average amount of milk-equivalent sold, used as the measure of volume of business, was 143,359 pounds each. This is equal to average daily sales of 46 gallons. The range in amount of daily sales was from 9 to 125 gallons per day.

Number of Units Sold

The annual sales in terms of units averaged 81,239. In terms of daily sales this is equal to a daily total of 223 containers of milk, cream, butter, cottage cheese, etc. The average unit sold contained less than

two pounds of milk-equivalent. The range in total number of units sold annually was from 22,804 to 208,121.

Total Cost of Distribution

The total annual cost of distribution averaged $2,784.67. Between markets it appeared to vary independently of volume of business, since in Parkersburg the average producer-distributor sold a larger volume of milk-equivalent at less total cost than did the distributor in the Charleston market. The range of individual costs was from $1,284.13 to $6,694.31. Between individuals the total cost was influenced considerably by the volume of business, although the smallest business did not have the lowest total cost, nor did the largest business have the highest total cost.

The average investment in buildings, plant, and delivery equipment and in accounts receivable was $2,306.38, the range being from $318.33 to $6,132.89.

Hours of Labor Used

The amount of labor used averaged 4,873 hours per producer-distributor. This is equivalent to one man working about 13½ hours per day for the year. The work was usually done, however, by several persons, and each usually had other work to do besides that connected with the distribution of milk. The total number of hours of distribution labor per retailer varied from 2,428 to 12,639.

Analysis of Distribution Costs

The costs of distributing 100 pounds of milk-equivalent are classified and shown in Table 2. Table 3 gives the percentages of the total cost contributed by each of the items.

Total Cost Per Cwt. of Milk-Equivalent Sold: $1.94

For the 67 records the average total cost of distribution was $1.94 per cwt. of milk-equivalent sold. However, there was considerable variation between markets. The average cost per cwt. in the Charleston market was $2.33, in Huntington, $1.91, and in Parkersburg, $1.52. Charleston costs were above average in practically all items, but by far the greatest differences were in labor and truck costs. Huntington costs were close to the average of all records, especially labor and truck costs, and were below average in bottle costs and "other" costs. The averages of all items of cost among Parkersburg producer-distributors were below the averages of all records, except bottle costs and depreciation, but here also labor and truck costs contributed most to the difference in total costs.

The range of individual costs naturally was considerably greater than the range between markets. The lowest cost was $1.14 and the highest, $5.87. Only five retailers, however, had costs averaging less than $1.30 per cwt. of milk-equivalent, and only six had costs averaging more than $3.00.

TABLE 2—*Average cost of distributing 100 pounds of milk-equivalent by 67 producer-distributors*

Item	Charleston	Huntington	Parkersburg	Average
Labor: operator	$ .58	$ .61	$ .44	$ .54
family	.20	.19	.05	.15
other	.33	.15	.22	.24
Total	..	..	..	.93
Repairs	.03	.01	.01	.02
Depreciation	.11	.09	.11	.10
Truck: depreciation	.16	.14	.09	.13
operation	.40	.34	.22	.32
Bottles and bottle exchange	.06	.02	.06	.05
Caps	.04	.03	.03	.03
Supplies	.08	.12	.07	.09
Taxes	.01	.01	.01	.01
Bad debts	.12	.08	.09	.10
Interest	.10	.07	.06	.08
Other	.11	.05	.06	.08
Total	$2.33	$1.91	$1.52	$1.94

Labor Cost: 93c

Labor was the largest single item of cost, amounting to 93c per cwt. of milk-equivalent sold, or 48% of the total cost. Differences between the labor costs of individual distributors were dependent on the efficiency with which the work was done, upon the type of labor, (whether the work was done by operator, family, or hired help), and upon wage rates. The range of individual costs was from 45c per cwt. up to $2.57.

The different types of labor: operator, family, and other, made up different parts of the total cost. In all markets the largest cost was for operator's labor, which averaged 54c per cwt. of milk-equivalent sold, or 27.9% of the total cost of distribution.

TABLE 3—*Classification of cost items on a percentage basis for 67 producer-distributors*

Item	Charleston	Huntington	Parkersburg	Average
Labor: operator	24.9	31.9	29.8	27.9
family	8.6	10.0	3.2	7.7
other	14.2	7.9	14.3	12.4
Total	...	...	...	48.0
Repairs	1.3	0.5	0.7	1.0
Depreciation	4.7	4.7	7.1	5.2
Truck: depreciation	6.9	7.3	6.2	6.7
operation	17.2	17.8	14.3	16.5
Bottles and bottle exchange	2.6	1.0	3.8	2.6
Caps	1.7	1.6	1.8	1.5
Supplies	3.4	6.3	4.6	4.6
Taxes	0.4	0.5	0.4	0.5
Bad debts	5.1	4.2	5.8	5.2
Interest	4.3	3.7	3.7	4.1
Other	4.7	2.6	4.3	4.1
Total	100.0	100.0	100.0	100.0

Family labor made up a smaller share of labor costs in all three markets than did operator's labor. The average cost of "other labor" for all records was 24c, which was 12.4% of the total cost of distribution.

Repairs and Depreciation: 12c

The cost of repairs to buildings and equipment amounted to 2c per cwt. of milk sold when all records were averaged. Depreciation of buildings and equipment (except trucks) averaged 10c, the total charge for repairs and depreciation amounting to 12c, or 6.2% of the total cost of distribution. The range of combined expenses for repairs and depreciation was from 1c to 39c. There were seven distributors having costs less than 4c and seven having costs of more than 20c.

While the total depreciation costs were similar in the three markets, they varied according to the proportions of the different types of investment making up the total. Except for such supplies as bottles, caps, washing powder, etc., which are normally kept on hand in about the same quantities the year around, buildings have the lowest rate of depreciation, and with a large proportion of the total investment made up by that in the milk house, total depreciation would be low. Equipment such as refrigerators, bottlers, washers, boilers, and crates has a higher rate of depreciation than buildings.

Truck: 45c

The highest rate of depreciation is on the truck, and though truck investment (included in "delivery equipment" in Table 11) is less than one-fourth of the total investment, truck depreciation alone was greater than the combined depreciation of buildings and all other equipment. Truck depreciation averaged 13c per cwt. of milk-equivalent sold.

Expenses for truck operation, including gas, oil, tires, repairs, licenses, insurance, etc., averaged 32c per cwt. of milk-equivalent sold.

Because most producer-distributors think of their trucks as a single item of expense in distribution, truck depreciation and truck operating expense were combined to give a single figure for "truck expense." This will appear in later tables and in discussion of factors affecting efficiency, where "truck expense" figures conform more closely to the usage among producer-distributors than do "truck operating expense" figures. This total truck expense averaged 45c, or 28.4% of the total cost of distribution.

Bottles, Caps, and Supplies: 17c

The average bottle cost was 5c per cwt. of milk-equivalent sold. In Charleston and Parkersburg bottle costs were about alike, 6.2c and 5.8c respectively. In the Huntington group, however, bottle costs amounted to only 2.1c per cwt. Differences in bottle costs were associated largely with the number of trips made per bottle.

Cap costs averaged 3c. Variations in cap costs were dependent largely on the size of the units sold.

Expenses for supplies varied widely between individuals as well as between markets. The average for all records was 9c. The supplies included under this item were: ice, washing compound, disinfecting materials, brushes, butter paper, etc.

The total expense for bottles, caps, and supplies averaged 17c per cwt. of milk-equivalent sold, or 8.7% of the total cost of distribution. There were four distributors having costs of less than 11c, the lowest being 5c, and there were seven having costs of more than 25c, the highest being 35c.

Taxes and Insurance: 1c

Taxes and insurance together amounted to 1c per cwt. of milk sold, 0.8c being for taxes and 0.2c for building insurance. Only 16 of the 67 producer-distributors had their buildings insured, however. For those that carried insurance, the average cost amounted to 0.9c per cwt. of milk-equivalent sold.

Bad Debts: 10c

Of the 67 producer-distributors in the study, 66 sold more or less milk on credit. All but four of the 66 had accounts which were not collectible. The average amount of such accounts incurred during the year was 10c per cwt. of milk-equivalent sold, which was 5.2% of the total cost of distribution. Besides the four distributors who had no losses, there were 19 that had losses of 3c or less per cwt. However, 13 had losses ranging from 16c to 49c per cwt.

Interest: 8c

While interest cost, like depreciation, varied with the amount of investment, the rate was uniform for all classes of investment, and, therefore, the interest cost per cwt. of milk-equivalent sold was more uniform than was that of depreciation. The average interest cost for all records was 8c. The range among individual producer-distributors was from 2c to 25c, there being five below 4c and five above 15c.

Interest cost represented 4.1% of the total cost of distribution.

Other Costs: 8c

The remaining items of cost, consisting of coal, water, electricity, gas, kerosene, telephone, milk dealer's licenses, and advertising are grouped together as "other costs," and together averaged 8c per cwt. of milk-equivalent sold, or 4.1% of the total cost of distribution. There was considerable variation in the amount and kind of expenses incurred under this heading. Depending on the size of the business and upon the kind of equipment used, any particular distributor might have practically all or very few of the different items of expense.

Total Cost of Distribution Per Quart: 4.17c

The costs per cwt. of milk-equivalent sold may not be understood as readily as costs per quart or per gallon. Since approximately 46.5 quarts may be bottled from 100 pounds of milk, dividing cost per cwt. by 46.5 will give the cost per quart. By use of this method of figuring, the costs per quart are shown in Table 4. The total cost averaged 4.17c for all markets. Charleston producer-distributors had an average cost per quart of 5.00c, in Huntington it was 4.10c, and in Parkersburg it was 3.27c.

Labor cost averaged 2.01c per quart, and the total truck expense was .97c.

TABLE 4—*Classification of costs on the quart basis: Average costs for 67 producer-distributors in the Charleston, Huntington, and Parkersburg markets*

Item	Cents per quart
Labor: operator	1.17
family	.32
other	.52
Total	2.01
Repairs	.04
Depreciation	.22
Truck: depreciation	.28
operation	.69
Bottles and bottle exchange	.10
Caps	.06
Supplies	.19
Taxes	.02
Bad debts	.22
Interest	.17
Other	.17
Total	4.17

CLASSIFICATION OF COSTS INTO PLANT, DELIVERY, ADMINISTRATIVE, AND INTEREST COSTS

Costs may be classified according to the part they take in the distribution process. On this basis there are: (1) plant costs, incurred in preparing milk and its products for delivery; (2) delivery costs, incurred in transporting milk from the plant to the consumer and making collections; (3) administrative costs, covering expenses that are neither a preparation nor a delivery operation but are unavoidable consequences of the operation of the business; and (4) interest costs, which are a charge for the use of the capital needed by the business. The costs arranged under these classifications are shown in Table 5.

Delivery costs included 58% of all costs, the total amount of delivery expenses being $1.12 per cwt. of milk-equivalent sold. Plant costs totaled 62c, or 32% of all costs.

The total administrative costs of 12c amounted to 6% of the total cost of distribution. Bad debts constituted the largest share of administrative costs, amounting to 10c out of the total of 12c.

TABLE 5—*Classification of plant, delivery, administrative, and interest costs for 67 producer-distributors*

Item	Costs per 100 pounds milk	Percentage of total costs
1. Plant costs: Total	$ .62	32
(a) Labor	.36	18
	(1.5 hours)	
(b) Depreciation	.10	5
(c) Supplies and repairs	.09	5
(d) Insurance and other	.07	4
2. Delivery costs: Total	1.12	58
(a) Labor	.57	30
	(1.9 hours)	
(b) Bottles, caps, and other supplies	.10	5
(c) Truck	.45	23
3. Administration: Total	.12	6
(a) Bad debts	.10	5
(b) Taxes	.01	1
(c) Advertising and licenses	.01	..
4. Interest: Total	.08	4
Total	1.94	100

Interest cost was 4% of the total cost and amounted to 8c per cwt. of milk-equivalent sold.

Classification of Fluid Sales

Data showing the proportionate amounts of milk sold at retail and wholesale, and the amounts of milk sold as whole milk, cream, or milk products, throw some light on the variation in costs between markets. Such data are given in Table 6. It is indicated that 65% of the milk-equivalent sold went at retail prices. The lowest percentage of retail sales was 58% in the Parkersburg group. Huntington and Charleston were close together with 69% and 68% retail sales. Wholesale outlets were generally stores and restaurants, though some consumers using large quantities paid only wholesale prices. Wholesale outlets generally increase the amount of milk sold per hour and per truck mile, and result in a lowering of costs.

Fluid Sales in the Form of Milk, Cream, and Other Products

The cost of distributing 100 pounds of milk-equivalent is influenced to some extent by the form in which it is sold. The concentrated products such as cream and butter have a high milk-equivalent per unit sold. Consequently, though the cost per unit of cream etc. may be as high as the cost per unit of fluid milk, the cost per 100 pounds of milk-equivalent is much lower for cream than for fluid milk. An average of 90% of fluid sales was fluid milk, while 9% was cream, and the remaining 1% was mainly in the form of butter. The group of other products is largely made up of skimmilk products, except for butter, this skimmilk being a part of the milk-equivalent that was calculated for cream and butter.

In the Charleston and Huntington markets fluid milk made up a relatively high percentage of fluid sales, 94 and 93% respectively.

Cream and other products were about the same in both markets, being 4% cream and 2% other products in Charleston, and 5% and 2% respectively in Huntington. Parkersburg distributors had relative low percentages of fluid milk and relatively high sales of cream, which was part of the reason for their lower costs. Fluid milk made up 80%, and cream made up 19% of fluid sales. Other products accounted for the remaining 1% of fluid sales.

TABLE 6—*Classification of fluid sales: Average for 67 producer-distributors*

Item	Charleston	Huntington	Parkersburg	Average
Percent of all fluid sales:				
Retail	68	69	58	65
Wholesale	32	31	42	35
Percent of milk equivalent sold as:				
Fluid milk	94	93	80	90
Cream	4	5	19	9
Other products	2	2	1	1
Units of milk sold in:				
Gallons	845	304	775	641
Quarts	44,161	44,691	40,145	43,325
Pints	17,072	17,520	40,902	23,274
½ pints	7,681	1,139	13,713	6,965
Total	69,759	63,654	95,535	74,205
Units of cream sold in:				
Gallons	.....	.....	219	56
Quarts	53	97	765	248
Pints	31	.....	180	58
½ pints	1,974	2,267	4,384	2,686
Total	2,058	2,364	5,548	3,048
Units sold as:				
Buttermilk	4,690	1,530	1,598	2,820
Skimmilk	672	69	1,012	590
Chocolate milk	233	.....	1,382	406
Butter	93	105	51	86
Cottage cheese	27	.....	169	54
Other	75	.....	.....	30
Total	5,790	1,704	4,212	3,986
Total units per year	77,607	67,722	105,295	81,239
Ave. size of unit	1.71	1.90	1.70	1.77

Units of Fluid Sales

The number and the kinds of units sold affect costs, as does also the form in which milk is sold.

The average producer-distributor sold 81,239 units annually. Of this number 74,205 units were fluid milk, 3,048 were cream, and 3,986 were other products. The average unit sold contained 1.77 pounds of milk-equivalent, and the cost of distribution per unit was 3.43c.

The average size of unit was smaller in Charleston than in Huntington because Charleston producer-distributors sold a larger number of half-pints of milk, and a larger number of units of "other products". Parkersburg producer-distributors had a small average size of unit because of the large proportion of their fluid sales that were in the form of pints and half-pints of fluid milk.

Cream was sold by 50 of the 67 producer-distributors in the study. Buttermilk was sold by 55. Seventeen producer-distributors sold some

skimmilk, five sold some chocolate milk, six sold some cottage cheese, and 35 sold some butter.

Factors Affecting Costs of Distribution

The most striking feature of the costs shown in the preceding pages is the difference in total costs between the three markets. In looking for the factors which might be responsible for this difference, a difference in volume of business is most noticeable. In order to show how much effect volume had on costs, and to show how it affected costs, the 67 records were divided into three groups, and significant data for each group were averaged. These averages are shown in Table 7.

Table 7—*Relation between volume of producer-distributors and costs and related data for 67 producer-distributors*

Item	Large-volume prod.-dist.	Medium-volume prod.-dist.	Small-volume prod.-dist.
Number of records	25	28	14
Range in size	391,000-150,000	149,000-100,000	99,000-28,000
Average pounds milk equivalent sold	212,793	119,452	67,185
Average daily sales (gallons)	69	38	21
Costs:			
Labor	$ .81	$1.01	$1.39
Interest	.07	.09	.10
Truck	.35	.53	.80
Other	.45	.47	.55
Total	1.68	2.10	2.84
Investment per cwt. milk sold	$1.47	$1.72	$1.96
Pounds milk per hour of labor	34.6	27.0	19.3
Total truck costs per mile (cents)	4.8	4.5	4.5
Trips per bottle	34	51	40
Percent milk sold retail	64	65	63
Truck miles per cwt. milk sold	7.3	11.8	17.5
Lb. milk sold per truck mile	13.7	8.5	5.7

Volume

There were 25 producer-distributors having large volume, that is, selling between 150,000 and 391,000 pounds of milk-equivalent annually. They averaged approximately 69 gallons per day. Twenty-eight producer-distributors had medium volume, selling 100,000 to 149,000 pounds annually. They averaged 38 gallons daily. The small volume producer-distributors numbered 14, and, within a range of 28,000 to 99,000 pounds, sold an average of 21 gallons per day.

Labor in Relation to Volume

The average cost of distribution per cwt. of milk-equivalent sold was $1.68 for large-volume and $2.84 for small-volume producer-distributors, a difference of $1.16. Labor cost amounted to 81c per cwt. with large-volume and $1.39 with small-volume distribution. The difference, 58c, was just 50% of the total difference in cost. The dif-

ference in labor costs was directly related to labor efficiency, as the amount of milk sold per hour of labor averaged 34.6 pounds with large volume, 27.0 with medium volume, and 19.3 with small volume.

Truck Expense in Relation to Volume

Truck expenses were next in importance to labor costs as a factor affecting total cost of distribution. Large-volume distributors had truck costs of 35c per cwt. of milk sold, as compared with costs of 80c for small-volume dealers. The difference, 45c, was 39% of the total difference. This was in spite of truck costs per mile that averaged 4.8c for large-volume as compared with 4.5c for small-volume producer-distributors. The reason for lower truck costs per cwt. of milk with large volume was due to the increased amount of milk sold per mile. Large-volume distributors sold 13.7 pounds of milk-equivalent per truck mile, medium-volume distributors sold 8.5 pounds, and small-volume distributors sold only 5.7 pounds per truck mile. Another way of stating this fact is in terms of truck miles per cwt. of milk-equivalent sold. On this basis the large producer-distributor traveled 7.3 miles, medium producer-distributors traveled 11.8 miles, and small producer-distributors traveled 17.5 miles in selling 100 pounds of milk-equivalent.

Investment in Relation to Volume

Interest costs reflect the effect of the amount of investment on costs of distribution, though there are other considerations here besides merely attempting to secure the lowest total cost of distribution. Large-volume distributors had an average interest cost of 7c per cwt. of milk-equivalent sold, while for small-volume distributors this cost amounted to 10c. These figures represent an average investment per cwt. of $1.47 and $1.96, respectively.

There is this to be said about investment per cwt. of milk: if it is due to efficient use of adequate equipment, it is true economy. However, low investment may be due to the use of equipment that is inadequate for the production of sanitary and high-quality milk. Such a condition was, fortunately, not common among the producer-distributors in this study, but where it occurs, the resulting poor quality of milk makes it difficult or impossible to maintain volume at the prevailing level of prices. The result is that business is lost or prices are cut, with no benefits to the distributor, and only temporary benefits to those consumers who do not recognize the dangers of low-quality milk or have no appreciation of good-quality milk.

The investment in buildings and equipment may be adequate to the more important sanitary requirements, and be low in relation to the volume of milk handled, but it may still be uneconomical. Mechanical bottlers, cappers, and bottle-washing machinery may save time worth considerably more for other duties. Use of equipment to shorten the time required for one man to do his work is another aid in obtaining the more competent hired help that is the need of many producer-

distributors; competency of help being one of the intangible factors affecting labor efficiency.

Other Costs in Relation to Volume

Important among the remaining items of expense were supplies, bad debts, and bottle costs. Cost of supplies was larger in the small-volume group, the difference between this group and the high-volume group being about 9c. Some of the ways in which large distributors reduced the amount of this item were: (1) purchases in large amounts to obtain quantity discounts; (2) use of more economical methods, such as steam sterilization instead of chemicals; and (3) less waste of materials. Losses from bad debts were larger among small distributors, the difference amounting to 5c per cwt. Items in which higher costs were sustained by the large producer-distributors were depreciation, bottles, and "other costs". Depreciation was higher because the additional investment of the large businesses was in equipment having relatively high rates of depreciation. "Other costs" were higher because of the greater use of fuel, electricity, and water from city supplies by the larger distributors.

Bottle costs varied little between groups. The trips per bottle were lowest for large-volume distributors.

Differences in percentage of retail sales were not significant.

Labor Efficiency

Because of the wide range of labor costs among the individual producer-distributors, and because labor cost constitutes the largest single item of distribution costs, there can be no question concerning the importance of labor efficiency. In order to show this, and to show some factors affecting labor efficiency, the records were divided into three groups according to the number of pounds of milk sold per hour of labor. The results of this classification are given in Table 8.

There were 21 distributors selling over 34 pounds of milk-equivalent for each hour of labor who may be considered to be efficient, 26 of average efficiency selling 23 to 33 pounds, and 20 inefficient distributors selling less than 23 pounds. The average amounts sold in each of these groups were 42.6, 28.0, and 19.7 pounds per hour respectively. These represent 2.3, 3.6, and 5.1 hours of labor per cwt. of milk sold.

The same relationship between labor efficiency and volume that was shown in Table 7 appears again in Table 8. The more efficient distributors sold 188,788 pounds of milk-equivalent annually, those of average efficiency sold 135,458 pounds, while the least efficient sold 105,928 pounds. This interrelation between volume and labor efficiency makes it impossible to ascribe a definite effect to each, and any results of a classification on the basis of one of the factors must take into account the effect of the other.

The average amounts of milk sold per hour of labor, while measuring labor efficiency, do not cause the only variation in the labor cost per cwt. of milk-equivalent sold. Labor cost in efficient businesses was 83c,

in average businesses was 96c, and for inefficient businesses averaged $1.10 per cwt. of milk-equivalent sold. It was affected by wage rates as well as efficiency, the wages paid in the three groups averaging 35.3c, 27.0c, and 21.6c respectively.

This difference in wage rates was due in part to a decrease in the amount of labor performed by the operator, with an increase in the amount of family labor. Operator labor was valued at a higher rate than family labor. The fact that larger amounts of family labor were used in the least efficient businesses is of some significance, aside from its effect on the average wage rate. From the standpoint of efficiency, an hour of average family labor was worth less than an hour of operator or other labor.

TABLE 8—*Efficiency of labor: Classification of producer-distributors on basis of pounds milk sold per hour of labor*

Item	Milk sold per hour of labor		
	34 pounds and over	23-33 pounds	Less than 23 pounds
Number of records	21	26	20
Range in pounds milk per hour	34-46	23-33	10-22
Average pounds milk sold per hour of labor	42.6	28.0	19.7
Average pounds milk-equivalent sold	188,788	135,458	105,928
Percent of total labor that was: operator's	48	42	38
family	9	16	25
other	43	42	37
Total hours of labor	4,430	4,834	5,389
Labor cost (c per hour)	35.3	27.0	21.6
Labor cost per cwt. milk sold	$ .83	$ .96	$1.10
Total cost per cwt. milk sold	1.52	2.00	2.63
Investment per cwt. milk sold	1.40	1.61	2.00
Miles traveled per cwt. milk sold	6.7	10.6	14.6
Customers per mile	3.0	2.2	2.4
Average size of unit sold	1.94	1.73	1.62

Difference in total costs per cwt. of milk-equivalent sold were larger than differences in labor costs. The total cost for efficient distributors was $1.52, while for inefficient distributors it was $2.63.

Investment in Relation to Labor Efficiency

The investment per cwt. of milk-equivalent sold was $1.40 for the efficient group, $1.61 for those of average efficiency, and $2.00 for the inefficient groups. This indicates that the total investment in each group was about the same. On the basis of this classification, then, there was no apparent relationship between investment and labor efficiency. High equipment investment, causing high interest and depreciation charges, was the result of low volume of business among inefficient producer-distributors. Short delivery routes decrease the amount of delivery labor required, and it would be expected that short routes would be found in combination with high efficiency. Such was the case, for

efficient producer-distributors traveled only 6.7 miles in delivering a cwt. of milk, those of average efficiency traveled 10.6 miles, and inefficient distributors traveled 14.6 miles per cwt. of fluid sales.

It was also shown that the size of unit sold had some influence on the amount of milk sold per hour. The efficient group handled units averaging 1.94 pounds each. The average weight for the moderately efficient group was 1.73 pounds, and for the inefficient group was 1.62.

Briefly, it was shown that the principal factors affecting labor efficiency were: (1) volume of business, (2) type of labor, and (3) number of miles traveled in selling a cwt. of milk. Also it was shown that with efficient use of labor, total distribution costs were greatly decreased.

TABLE 9—*Quantity, type, and value of labor used by 67 producer-distributors*

Item	Charleston	Huntington	Parkersburg	Average
Operator's labor:				
Hours per retailer	2,016	2,072	2,158	2,071
Value per hour (cents)	38	39	38	38
Family labor:				
Hours per retailer	869	1,068	421	824
Value per hour (cents)	31	23	21	26
Other labor:				
Hours per retailer	2,412	1,258	2,265	1,974
Value per hour (cents)	18	15	17	17
Total hours per retailer	5,297	4,398	4,844	4,873
Average value per hour (cents)	28	28	27	28
Percent of total hours:				
Operator	38	47	44	42
Family	16	24	9	17
Other	46	29	47	41
Total	100	100	100	100
Percent of total hours:				
Plant operations	45	43	45	44
Delivery operations	55	57	55	56
Pounds of milk sold per hour of labor	28.2	29.4	37.1	29.4

Quantity, Type, and Value of Labor

It was pointed out in the discussion of labor costs that these are affected by the type of labor and wage rates. The number of hours and value per hour of each kind of labor are given in Table 9 for each market. The average amount of labor used was 4,873 hours. Of this amount of labor, the operators worked an average of 2,071 hours. The operator labor did not vary greatly in amount or estimated value between markets. It made up 42% of the total hours of labor and 58% of the total cost. Operators estimated the value of their labor at 38c per hour. This was much higher than for the other types of labor, but most operators were better trained and more concerned with the outcome of the work, hence worked more efficiently than most of the workers included under family or "other" help.

Family labor amounted to 824 hours per distributor, or 17% of the total amount of labor. The average value was 26c. There was much variation, however, in total amount, percentage, and value between

markets. In Huntington and Parkersburg occurred the extremes in amount of family labor, 1,068 and 421 hours, respectively. It had about the same value in both cases, 23c in Huntington and 21c in Parkersburg. In Charleston, where 869 hours of family labor were used, the average value was 31c per hour.

"Other labor" varied in amount in about the same proportion that total labor varied. It averaged 1,974 hours per distributor, and made up 41% of all labor.

The percentage of the total amount of labor spent in plant operations and in delivery operations is also shown in Table 9. It averaged 44% on plant operations and 56% on delivery operations.

TABLE 10—*Classification of producer-distributors business data based on investment per 100 lbs. of milk sold*

Item	Investment per 100 pounds milk sold		
	Below $1.30	$1.30 to $1.99	$2.00 and over
Number of records	19	28	20
Range in investment per cwt.	$.44-1.29	$1.30-1.99	$2.00-5.06
Average investment per cwt.	$.89	$1.56	$2.60
Average pounds milk equivalent sold	160,352	147,463	121,468
Investment per distributor	$1,426.63	$2,298.12	$3,153.71
Labor cost per cwt.	$ .86	$ .86	$1.16
Depreciation costs per cwt.*	.17	.24	.32
Interest costs per cwt.	.04	.07	.13
Total costs per cwt.	1.64	1.80	2.57
Hours labor per cwt.	3.0	3.2	4.2
Cost of labor per hour (cents)	29	27	28

*Includes depreciation of truck.

Investment

In Table 10 some of the data are grouped according to the amount of investment per cwt. of milk-equivalent sold. There were 19 producer-distributors having an investment of less than $1.30 per cwt. of milk sold, 28 having $1.30 to $1.99. and 20 having $2.00 to $5.06 invested for each cwt of fluid sales. The average investment in the three groups was 89c, $1.56, and $2.60, respectively. There was some difference between groups in the amount of milk sold, but not as much as between efficient and inefficient distributors, or between large and small-volume business. Consequently, volume differences do not contribute so much to the variation of other factors in the table.

The range of total investments per distributor was very wide, the high investment group having over two times as large an investment as the small investment group; 214% to be exact. The total investment of the medium group was 161% of that of the small group, or about midway between the small and the large groups.

It is the comparison between the small and the medium-investment groups that is of particular interest. Both had identical labor costs, amounting to 86c per cwt., although the smaller volume of sales in the medium-investment group would otherwise result in slightly higher costs per cwt. There was a slight difference in the number of hours of labor expended in handling a cwt. of milk. Low-investment distributors

used 3.0 hours and medium-investment distributors used 3.2 hours. However, the difference, 0.2 hour, was not as great as would ordinarily result from the difference in volume. It is probable that the low-investment group had insufficient equipment for efficient use of labor.

Depreciation and interest costs show the direct effect of size of investment on costs, both items of cost increasing proportionately with the size of investment.

Total cost of distribution, however, increased less from the low to the medium-investment group than it did from the medium to the high-investment group. From low to medium the costs increased 17c. From medium to high the costs increased 77c. Since this 77c increase was made up of 30c of labor cost, 8c depreciation, and 6c interest, it is apparent that high investment without regard to labor efficiency tends to a considerable increase in the cost of distribution.

It is significant to note the items of investment in which increases were made. Between low and medium investment, 43% of the increase was in plant equipment, and 27% was in buildings. Between medium and high investment, however, only 35% of the increase was in plant equipment, and 48% was in buildings. The remainder of the investment in all cases was in delivery equipment and accounts receivable, relative increases of these items being quite small.

TABLE 11—*Classification of investment of 67 producer-distributors*

Item	Average Investment			
	Charleston	Huntington	Parkersburg	Average
Buildings	$ 581.49	$ 603.99	$ 604.37	$ 595.01
Equipment and supplies:				
Plant	1,013.20	459.76	869.49	786.75
Delivery	635.86	492.02	563.14	569.54
Accounts receivable	404.97	337.27	299.92	355.08
Total investment	2,635.52	1,893.04	2,336.93	2,306.38
Percent investment in:				
Buildings	22	32	26	26
Plant equipment	39	24	37	34
Delivery equipment	24	26	24	25
Accounts receivable	15	18	13	15
Total	100	100	100	100

Classification of Investment

The average total investment of producer-distributors represents three types of property: buildings, equipment, and accounts receivable. Table 11 shows how the total was distributed between these items, equipment being divided into plant and delivery equipment.

The average value of buildings was $595.01. Between markets it varied less than $15 from that figure. This figure includes the value of the milk house and garage for the delivery truck.

The greatest variation was in plant equipment investment. It averaged $786.75, but amounted to $1,013.20 in the Charleston market, $459.76 in the Huntington market, and $869.49 in Parkersburg. Plant equipment consisted of cooling, bottling, and refrigerating equipment, and cleaning and sterilizing supplies. Mechanical refrigerators made

up the largest part of the investment in plant equipment where they were used. Delivery equipment varied in the same order, but within a smaller range. Articles of equipment included under this heading were: bottles, caps, crates, stationery (such as billheads), and trucks.

Accounts receivable included accounts outstanding for the month immediately preceding the inventory date, plus older accounts that the operator considered collectible. Bad debts or accounts that were not collectible were not included. The average value of accounts receivable was $355.08.

Truck Efficiency

Truck costs comprise 23.2% of the total cost of distribution. Those costs are practically all cash expenses, and are nearly always carefully studied by the individual producer-distributor. Consequently, each has usually adapted his truck and route to his business in the most efficient manner possible. However, it was found that some businesses had an exceptionally efficient combination of factors influencing truck costs, and others had quite inefficient combinations. The average value of some factors indicating truck efficiency are given in Table 12.

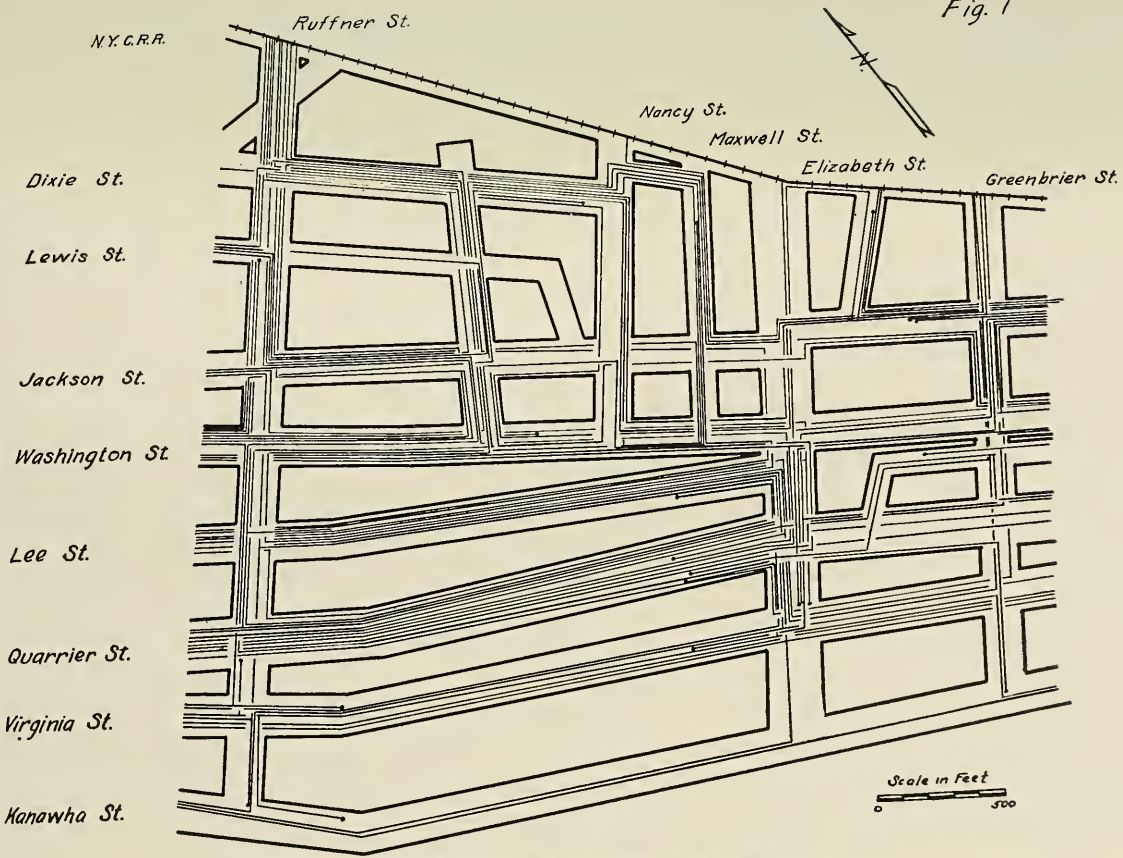
TABLE 12—*Other factors affecting costs: Variation between markets and the average of three markets*

Items	Charleston	Huntington	Parkersburg	Average
Average pounds milk equivalent sold	132,334	129,401	179,753	158,667
Labor cost per hour (cents)	28	28	27	28
Milk sold per hour of labor (pounds)	28	29	37	29
Truck miles per cwt. milk sold	11.9	11.4	6.0	9.9
Milk sold per truck mile (pounds)	6.1	8.8	16.7	10.1
Customers per mile	2.0	1.9	3.1	2.5
Truck costs per mile (cents)	4.1	4.3	5.2	4.6
Pounds milk per unit sold	1.71	1.91	1.70	1.77
Trips per bottle	38	67	28	39
Investment per cwt. milk	$1.99	$1.46	$1.31	$1.61
Miles from town	7.3	6.0	4.1	6.0
Total miles of route per distributor	46.3	39.8	29.5	39.8

The factor of miles of truck travel is perhaps the most important one affecting truck costs per cwt. of milk sold. This is dependent on two considerations, each of which may be broken down into innumerable items. The two principal considerations affecting truck costs are: (1) total miles of route, and (2) total daily sales.

The total route mileage consists of two parts. The first is the distance from the farm to (usually) the city limits, or the limits of the urban area in which the milk is distributed. This distance is, for all practical purposes, irreducible, since the location of a producer-distributor's farm is usually determined by more important considerations than distance from town.

The differences in average distance from town are one reason for the differences in costs between markets. It averaged 7.3 miles for the



Duplication of Milk Routes in Charleston, West Virginia

Charleston group, 6.0 miles for the Huntington group, and 4.1 miles for the Parkersburg group.

The second part of the total route mileage is in the travel between customers. Under ideal conditions, this part of the route would also be irreducible without loss of volume. The ideal situation, of course, is to have all customers in adjacent houses. However, if such an ideal situation ever prevails it is soon broken up because good customers move to other neighborhoods and still want milk from their former dairymen, and some customers in the old neighborhood find reasons for dissatisfaction and want a new dairyman. Consequently, customers become widely scattered, and the town part of the delivery route becomes an elastic thing. It is stretched to reach new customers, and occasionally shortened by cutting off customers.

In an effort to show the extent of duplication of delivery facilities that resulted from the scattering of customers, route maps were prepared by most of the distributors in this study. The routes showed that most distributors had customers in nearly all parts of the city they served, and that any one section was served by a large number of distributors. One area in Charleston was selected at random, and the routes found in it were drawn on a single map (Fig. 1). This area, bounded by Ruffner, Kanawha, and Elizabeth streets and the New York Central Railroad, was a little over a half mile long on each of three sides, and slightly under a half mile on the fourth. It contains about one-third of a square mile. Out of the 23 producer-distributors from whom maps were obtained, 20 sold milk in that area. Figure 1 shows the routes traveled. Each line represents the route of one producer-distributor, and no more than one line is used even though he may have retraveled a street one or more times. East and West streets are "through" streets, but only two lines cross the area without turning into one of the cross streets, and they represent distributors whose routes again entered the area at other places in such a way as to indicate that they had customers in it. Figure 1 is not a complete picture of the duplication of milk routes in the area, however, because the figure only shows how much use was made of the area by 26 producer-distributors. (One of the 27 studied in the Charleston market presumably used the area but furnished no route map.) There were 44 producer-distributors licensed to distribute milk in the Charleston market when the study was commenced, so that in the area shown in Figure 1 the number of producer-distributors serving it was probably twice as great as is shown.

Figure 1 shows that excessive duplication was a real condition. It is less easy to show what can be done about it, and most difficult of all to do something about it, though in many cases something should be done. Distributors may reduce the number of their customers to the number that may be served most efficiently. They may refuse to go beyond the area enclosed by the most efficient portion of their route in search of new customers, or in following old ones, and they may trade customers with other distributors where the change will be acceptable to the consumer and will strengthen the routes of both distributors.

On the average, delivery expenses were not excessively high, but some individual distributors may be faced with high delivery costs that could be decreased by one or more of the above-mentioned remedies.

Total miles traveled daily averaged 46.3 in Charleston, 39.8 in Huntington, and 29.5 in Parkersburg. The average numbers of miles traveled within city limits, or within the principal delivery area, were respectively 30.9, 26.6, and 21.3, the difference equalling the mileage traveled between farm and town. (Not equal to distance from farm to town, since several distributors made two trips daily, or operated two trucks.)

The factor of total miles traveled as a principal factor affecting truck efficiency is to some extent directly related to the other principal factor, total sales of milk. However, volume may be obtained with a large percentage of wholesale customers or a large number of customers per mile traveled, whether the route is long or short. Thus low truck costs in the Parkersburg market were partly a result of the large percentage of wholesale sales (Table 6), and partly because of the number of customers per mile traveled, which averaged 3.1, as compared with 2.0 customers per mile in Charleston, and 1.9 in Huntington.

Bottle Losses

Bottle losses and exchange costs made up 2.6% of the total cost of distribution. The bottle costs for different distributors, however, varied widely, and the average costs perhaps do not give a true picture of the situation that exists. Several distributors bought no bottles, and lost none, so that their only bottle expense was their exchange or association fee. Such efficiency was in part offset by the failure of other distributors to get more than 12 to 20 trips per bottle.

Charleston and Parkersburg had bottle associations, which used a single registered bottle. The Charleston association purchased and supplied as many bottles as were needed by its members, the cost being assessed to them according to their average daily sales. Such an association has the advantage of large-scale purchasing. However, it is not necessarily effective in reducing the average bottle losses in a given market, since the individual incentive to check up on bottle returns is somewhat lessened. This may explain the few trips per bottle obtained in Charleston and Parkersburg as compared with Huntington.

Individual attention of each producer-distributor to collection of bottles, requirement of a cash deposit on bottles, the use of registered bottles, and some type of efficient bottle exchange are the steps to be taken in reducing high bottle costs.

Comparison of Costs Found in Three Cost-of-Milk-Distribution Studies

The results of the study of milk distribution costs published in this bulletin are interesting in comparison with the results of the previous studies of costs incurred by producer-distributors and by milk-plants. Tabulations of these results are given in Tables 13 and 14.

The average costs of distribution for producer-distributors in the Clarksburg, Fairmont, Morgantown, and Wheeling markets in 1934-35

TABLE 13—*Comparisons of costs: 22 milk-distributing plants in West Virginia for 1933, 75 producer-distributors for 1934-35, and 67 producer-distributors for 1935-36*

Cost items per 100 lb. of milk	67 Producer-distributors 1935-36	75 Producer-distributors* 1934-35	22 Plants*
Total Costs	$1.94	$1.76	$2.05
Labor	.93	.89	.84
Depreciation	.23	.16	.22
Buildings and equipment	.21	.22	.39
Truck operation†	.32	.30	.18
Loss of milk‡	..	..	.05
Bad accounts	.10	.09	.07
Interest	.08	.07	.18
Advertising	..	..	.02
Other costs	.07	.03	.10

*Data from West Virginia Bulletins 266 and 270, "Milk-Distribution Costs in West Virginia".

†Does not include truck depreciation. See Table 2.

‡Cost data for producer-distributors were based on fluid sales, whereas cost data for plants were based on milk entering plant.

were $1.76, and in Charleston, Huntington, and Parkersburg in 1935-36, $1.94. The difference was largely in labor, depreciation, and in the items included among "other costs". Building and equipment costs (including repairs, supplies, and taxes), bad accounts, and interest costs were practically the same. Labor costs for the 1935-36 study were 93c, and for 1934-35 were 89c per cwt. of milk sold, the difference being due entirely to difference in rates per hour, which were 27.6c and 24.7c respectively.

The higher depreciation in 1935-36 was due to a higher proportion of the total investment that was in plant equipment, with a smaller investment in buildings and accounts receivable.

The comparison of producer-distributor costs with plant costs was discussed in some detail in West Virginia Bulletin 270, and it is necessary here only to mention that the conclusions reached at that time are sub-

TABLE 14—*Comparison of some of the factors affecting costs of 22 milk-distributing plants for 1933, 75 producer-distributors for 1934-35, and 67 producer-distributors for 1935-36*

Item	67 Producer-distributors 1935-36	75 Producer-distributors 1934-35	22 Plants
Average pounds milk equivalent sold	143,359	122,627	1,606,526
Average number of units sold	81,239	67,557	701,540
Average pounds milk per unit	1.77	1.81	2.29
Percent of total sales were fluid milk	89.4	86.0	56.1
Percent of total sales were wholesale	35.2	27.2	69.6
Wage rate, cents per hour	27.6	24.7	36.5
Milk sold per hour of labor (pounds)	29	28	42
Investment per cwt. milk sold	$1.61	$1.48	$3.14
Trips per bottle	39	48	23
Percent labor cost was of total cost	48	50	41
Cost of delivery—cents per quart	4.17	3.79	4.41
Value of accounts receivable per cwt. milk sold	.25	.63	.55

stantiated by the present work. Labor costs were lower for plants than for producer-distributors, being 84c and 93c, respectively, per cwt. of milk sold. At the same time, plants paid higher wages, these averaging 36.5c per hour in plants and 27.6c among producer-distributors. Truck operating costs were considerably less among plants, averaging 18c per cwt. among plants and 32c among producer-distributors.

Interest costs were high with plants, 18c as compared with 8c. This was due to the greater investment in buildings for milk plants. It also was reflected in the high building and equipment expense, which was 39c for plants as compared with 21c for producer-distributors.

A significant difference between producer-distributors and plants is seen in type of sales. Producer-distributors in the two studies sold 89.4% and 86.0%, respectively, of their total sales as fluid milk. Plants, however, sold only 56.1% as fluid milk, the remainder being sold as cream or other products. One result of this was the larger average size of units sold by plants. They averaged 2.29 pounds per unit, while producer-distributors in the northern group sold 1.81 pounds per unit, and the central group sold 1.77 pounds. Another factor of this same type is the percentage of sales at wholesale prices. While this amounted to 35.2% for producer-distributors in the 1935-36 study, it averaged 69.6% for the plants (1933).

The amount of milk sold per hour of labor is the reason that plants had lower labor costs with higher wage rates. They handled 42 pounds of milk-equivalent per hour of man labor, as compared with 29 pounds per hour for producer-distributors in 1935-36.

Investment per cwt. directly affects interest cost. The milk plants had an average investment of $3.14 per cwt. of milk-equivalent sold, while the corresponding figure for producer-distributors was $1.61. The equipment represented by investment was probably responsible for much of the efficiency of man labor in the plants.

The higher costs for distributing plants can be attributed to such things as pasteurization, additional services to consumers, higher labor costs per hour, and the greater amount of administrative labor in the operation of a milk plant.

Summary and Conclusions

A study of the costs of distributing milk by 67 producer-distributors in the Charleston, Huntington, and Parkersburg markets showed the average cost per cwt. to be $1.94, ranging among individuals from $1.14 to $5.87.

The most important items of cost were labor and truck expense. Labor cost, averaging 93c per cwt., was 48% of the total costs, and truck expenses of 45c were 23.2% of all costs. Remaining costs were: depreciation, 10c; repairs, 2c; bottles and caps, 8c; supplies, 9c; taxes, 1c; bad debts, 10c; interest, 8c; and other expenses, 8c per cwt.

Classifying the records on the basis of volume of sales revealed that producer-distributors selling an average of 69 gallons of milk-equivalent daily had an average cost of distribution of $1.68, while those selling 21

gallons daily had an average cost of $2.84. Large volume reduced costs through its effect on labor efficiency and truck efficiency, as well as through the distribution of fixed costs over the larger amount of milk.

Labor efficiency was affected by the type of labor used, wage rates, miles of truck travel, amount of investment, and the average size of unit sold. Operator labor was most efficient, and the better paid hired labor was next. With efficient use of labor, total cost of distribution averaged $1.52 per cwt., while with inefficient use of labor the total cost averaged $2.63 per cwt.

Truck efficiency was affected by length of route, number of customers per mile, and amount of milk sold per customer.

From the low-investment group to the medium-investment group there was an increase of 16c in total cost per cwt., largely because of smaller volume in the medium investment group. From the medium to the high-investment group there was an increase of 77c in total costs. For a given volume of sales, an average investment in buildings and equipment resulted in no appreciable increase in total costs over low investment. The amount of investment is important with respect to the quality of milk produced as well as with respect to costs.

Comparing the business of producer-distributors with milk-distributing plants showed that a tendency toward higher costs among plants was due to: higher labor wages, the additional costs of pasteurization, greater administrative costs, higher investment in real estate and equipment, and the rendering of special services.